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FINAL REPORT ON CONTRACT N00014-75-C-0695.(U)
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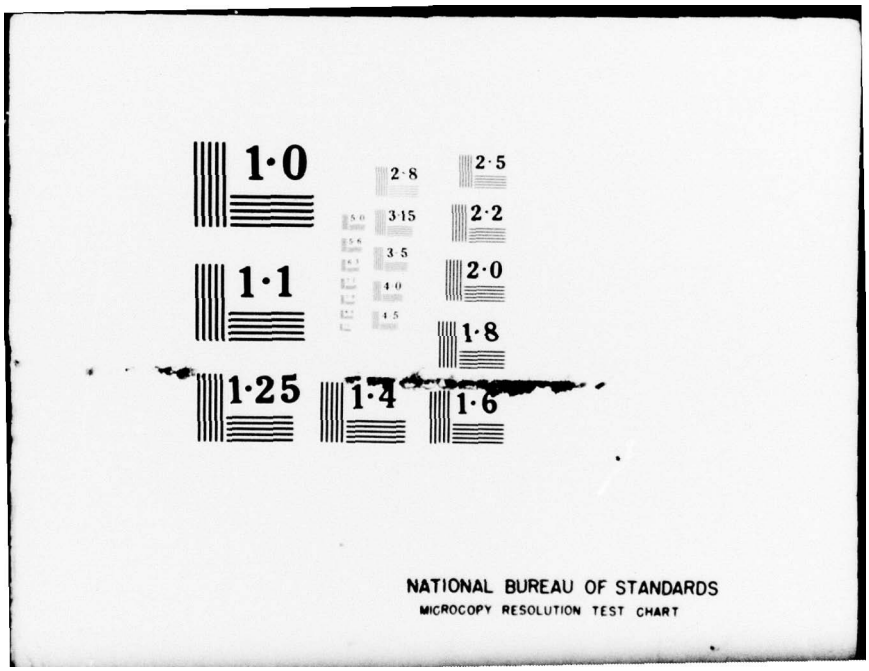
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FINAL REPORT

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FINAL REPORT

ON

CONTRACT N00014-75-C-0695

OFFICE OF NAVAL RESEARCH

PROJECT NR 064-428

The Contract began on Oct. 1, 1974 and ended on June 30, 1977. The research was directed by Professor Hans Bleich as Chief Investigator.

The Contract and three previous ones, NONR 266(08), NONR 266(86) and N00014-67-A-0108-0029 are principally concerned with dynamic interaction problems between solids and fluids, with emphasis on explosion, impact or acoustic situations of interest to the U.S. Navy. As a secondary subject, static and transient dynamic problems such as shock propagation in inelastic solids have been studied. The results of the investigations are described and recorded in the technical reports listed in the Appendix.

Because of the continuity of the subject, the Appendix lists reports issued under old Contracts listed above consecutively numbered. Reports one to 48 inclusive were issued under the earlier Contracts, Reports 49 to 52 inclusive were issued under this Contract.

It is noted that research on related subjects is being continued by the Chief INVESTIGATOR UNDER Contract N00014-72-C-0119 with the Office of Naval Research.

One significant result obtained under the latest contract is contained in the reports issued under Contract N00014-72-C-0119. The analysis concerns extension of earlier approaches to determine the interaction of a plane shock front with an infinitely long cylindrical shell. The new approach is intended for finite shells with stiffeners and bulk heads.

A second significant results concerns plastic buckling of plates. Unexplained discrepancies of long standing in applying incremental theory of plasticity to plate buckling problems have now been explained, Rpt. No. 50. It appears that in tests on plate buckling frictional effects near the heads of the testing machines occur and can not be avoided. The additional stresses in the plate reduce its carrying capacity appreciably.

Technical Reports Under Project NR-64-428

H. Bleich and M. Salvadori, Technical Report No. 1, Vibration Analysis of Elasto-Plastic Structures with Application to Impulsive Motion, February 1952.

M. G. Salvadori and F. DiMaggio, Technical Report No. 2, On the Development of Plastic Hinges in Rigid-Plastic Beams, February 1952.

R. D. Mindlin and H. H. Bleich, Technical Report No. 3, Response of an Elastic Cylindrical Shell to a Transverse, Step Shock Wave, March 1952.

M. L. Baron and F. DiMaggio, Technical Report No. 4, Elasto-Plastic Whipping and Knifing of Submarine Hulls Under Dynamic Forces, (Confidential), 1952.

M. L. Baron and H. H. Bleich, Technical Report No. 5, Effect of Non-Equally Distributed Mass and Stiffness on the Vibrations of Circular Rings, (Confidential), 1952.

H. H. Bleich and F. DiMaggio, Technical Report No. 6, A Strain-Energy Expression for Thin Cylindrical Shells, September 1952.

M. L. Baron and H. H. Bleich, Technical Report No. 7, Tables for the Frequencies and Modes of Free Vibration of Infinitely Long, Thin Cylindrical Shells, September 1952.

H. H. Bleich and M. L. Baron, Technical Report No. 8, Free and Forced Vibrations of an Infinitely Long Cylindrical Shell in an Infinite Acoustic Medium, December 1952.

H. H. Bleich, Technical Report No. 9, Radiation From a Sound Source Beside a Cylindrical Shell Submerged in an Infinite Medium, October 1953.

M. L. Baron and H. H. Bleich, Technical Report No. 10, Further Studies of the Response of a Cylindrical Shell to a Transverse Shock Wave, December 1953.

M. L. Baron, Technical Report No. 11, Circular Symmetric Vibrations of Infinitely Long Cylindrical Shells with Equidistant Stiffness, September 1954.

H. H. Bleich and F. L. DiMaggio, Dynamic Buckling of Submerged Plates and Shells, Technical Report No. 12, September 1954.

P. C. Gondikas, Technical Report No. 13, Vibrations of Ring Stiffened Cylindrical Shells, March 1955.

H. H. Bleich, Technical Report No. 14, Approximate Determination of the Frequencies of Ring Stiffened Cylindrical Shells, March 1955.

R. Skalak, Technical Report No. 15, An Extension of the Theory of Water Hammer, March 1955.

H. H. Bleich, Technical Report No. 16, Response of Elasto-Plastic Structures to Transient Loads, February 1956.

M. L. Baron, Technical Report No. 17, Response of Non-Linearly Supported Boundaries to Shock Waves, Case of the Spherical Cavity, (Confidential) 1956.

M. B. Friedman, Technical Report No. 18, The Method of the Green's Function Applied to the Diffraction of Pulse by Wedges, November 1956.

M. L. Baron and H. H. Bleich, Technical Report No. 19, Initial Velocity in Shells at a Free Surface Due to a Plane Acoustic Shock Wave, November 1956.

H. H. Bleich and R. Shaw, Technical Report No. 20, Dominance of Shear Stresses in Early Stages of Impulsive Motion of Beams, October 1957.

D. J. Butler, Technical Report No. 21, Vibrations of an Infinitely Long Cylindrical Shell in a Semi-Infinite Acoustic Medium, May 1958.

M. B. Friedman, Technical Report No. 22, Acoustic Pulse Loading on a Two-Dimensional Rigid Box in the Vicinity of a Free Surface, May 1959.

H. H. Bleich, Technical Report No. 23, Excitation of Distributed Systems, October 1959.

J. Lubliner, Technical Report No. 24, Surface Waves in a Visco-Elastic Half-Space, April 1960.

M. B. Friedman and R. Shaw, Technical Report No. 25, Diffraction of a Plane Shockwave by an Arbitrary Rigid Cylindrical Obstacle, October 1960.

H. H. Bleich, Technical Report No. 26, Dynamic Interaction Between Structures and Fluid, November 1960.

H. M. Berkowitz, Technical Report No. 27, Longitudinal Impact of a Semi-Infinite Elastic Cylindrical Shell, January 1961.

H. M. Berkowitz and H. H. Bleich, Impact of an Elastic Truncated Conical Shell, Technical Report No. 28, January 1961.

R. P. Shaw and M. B. Friedman, Technical Report No. 29, Diffraction of Pulses by Arbitrary Two-Dimensional Free Surfaces, December 1961.

J. Lubliner, Technical Report No. 30, Virtual Mass Terms Associated with Motions of a Submerged Flexible Rectangular Cylinder, October 1962.

R. Skalak and D. Feit, Technical Report No. 31, Impact on the Surface of a Compressible Fluid, January 1963.

J. Lubliner, Technical Report No. 32, Effect of an Elastic Plate on the Acoustic Field of a Point Source, July 1963.

J. Lubliner, Technical Report No. 33, A Generalized Theory of Strain-Rate-Dependent Plastic Wave Propagation in Bars, August 1963.

R. Testa and H. H. Bleich, Technical Report No. 34, Effect of a Shock Wave on a Floating Rectangular, Rigid-Plastic Structure, April 1965.

D. Feit, R. Skalak and H. Bleich, Technical Report No. 35, Impact of a Flat Elastic Wedge on a Compressible Fluid, November 1964.

H. H. Bleich and I. Nelson, Technical Report No. 36, Plane Waves due to Combined Pressure and Shear Loads on an Elastic-Plastic Half-Space, January 1965.

M. B. Friedman and M. K. Myers, Technical Report No. 37, Effect of a Plate and Damping on the Acoustic Field of a Point Source in an Adjoining Fluid, April 1965.

H. H. Bleich and A. Matthews, Technical Report No. 38, Effect of a Step Load Moving on the Surface of an Elastic-Plastic Half-Space, December 1965.

M. A. Schoenberg and H. H. Bleich, Technical Report No. 39, Finite Deflections of Viscoelastic Rings, July 1967.

Michael K. Myers and Morton B. Friedman, Technical Report No. 40, Focusing of Supersonic Distrubances Generated by a Slender Body in a Non-Homogeneous Medium, June 1966.

R. B. Testa, Technical Report No. 41, A Numerical Solution for Longitudinal Waves in a Cylindrical Shell, April 1967.

A. Harari, Technical Report No. 42, On Overall Buckling of Vessels Composed of Combinations of Cylindrical and Spherical Shells, April 1967.

H. H. Bleich and I. Sandler, Report No. 43, Dynamic Interaction Between Structures and Bi-linear Fluids, April 1968.

M. K. Myers and H. H. Bleich, Report No. 44, Transient Excitation of a Liquid Half-Space by a Decelerating Load and the Associated Transonic Effects, April 1969.

I. S. Sandler and H. H. Bleich, Report No. 45, Effects of a Step Load, Progressing with Rayleigh Speed on the Surface of an Elastic Half-Space, August 1969.

J. Ginsberg and H. H. Bleich, Report No. 46, Forced Nonlinear Vibrations of Cylindrical Shells of Infinite Length, September 1970.

H. H. Bleich, Report No. 47, On the Possibility of Observing Nonlinear Effects in the Vibrations of Cylindrical Shells in Vacuo or Submerged, June 1971.

H. H. Bleich, Report No. 48, On Uniqueness in Ideally Elastoplastic Problems in Case of Nonassociated Flow Rules, March 1973.

H. H. Bleich, F. L. DiMaggio and M. L. Baron, On Uncoupling Fluid Structure Interaction Problems, Progress Reports, Part I, March 1973, Part II, July 1973, issued under Contract NOOO14-72-C-0119.

H. H. Bleich, F. L. DiMaggio and M. L. Baron, Acoustic Approximations for Uncoupling Fluid-Structure, Interaction Problems, Tech. Rpt. No. 13, July 1974, issued under Contract NOOO14-72-C-0119.

D. Ranlet, H. Bleich, F. DiMaggio and M. Baron
"Transient Response of Submerged Shells of Finite Length to Full Envelopment Type Shock Waves--Part IV: Comparison of Predicted and Measured Results for Side-On Loading of a Shell Containing Internal Structures-Configuration 1", ONR Contract N00014-72-C-0119, TR No. 17, Dec. 1974.

D. Ranlet, F. DiMaggio, H. Bleich and M. Baron, "An Improvement in the Use of the Doubly Asymtotic Approximation in Predicting the Transient Response of Submerged Shells of Finite Length to Full-Envelopment Shock Waves", ONR Contract N00014-72-C-0119, TR No. 18, Feb. 1975.

S. Shrivastava and H. Bleich
"Inelastic Buckling of Plates Allowing for Shear Effects", ONR Contract N00014-75-C-0695, TR No. 49, Aug. 1975.

D. Ranlet, H. Bleich, F. DiMaggio and M. Baron,
"Transient Response of Submerged Shells of Finite Length to Full Envelopment Type Shock Waves--Part V: Comparison of Predicted and Measured Results for Side-on Loading on a Shell Containing Internal Structures-Configuration 3", ONR Contract N00014-72-C-0119, TR No. 19, Aug. 1975.

A. Gjelsvik and G.-S. Lin, "Report No. 50,Plastic Buckling of Plates with Edge Frictional Shear Effects" ONR Contract N00014-75-C-0695, July 1976.

H. Bleich, Report No. 51, "Strain Energy Expressions of Rings of Rectangular, T- and I- Section, Suitable for the Dynamic Analysis of Ring-Stiffened Cylindrical Shells." ONR Contract N00014-75-C-0695, Oct. 1976.

G. Nikolakopoulou and F.L. DiMaggio, Report No. 52, Dynamic Elastic-Plastic Response of Fluid-Filled Containment Vessels, forthcoming.

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Plain Shock Waves, Cylindrical Shells, Plastic Buckling

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

List of Technical Reports issued in this and preceding contracts.

Interaction of plane shock wave with stiffened shells of finite length.

Explanation of discrepancies, up to now unexplained, in the theory of plastic buckling of plates.

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